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Title: A Database Study of Cataract Surgery Outcomes in the setting of Primary Epiretinal Membrane

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Key Points:

Question: In the setting of cataract and primary epiretinal membrane (ERM), what is the visual impact and incidence of cystoid macular edema (CME) after cataract surgery?

Findings: A retrospective clinical database study involving 812 ERM eyes and 159,184 reference eyes undergoing phacoemulsification cataract surgery showed an increase in visual acuity (VA) of 0.27 LogMAR units (~3 Snellen lines) and an 8.6% incidence of CME in eyes with primary ERM.

Meaning: Cataract surgery in eyes with primary ERM leads to a significant improvement in VA but higher rates of CME, and a lower postoperative VA gain as compared with cataract surgery in eyes without primary ERM.

Abstract:

Importance: Primary epiretinal membrane (ERM) is a common retinal disorder with a prevalence of 4-18.5%. While ERM and cataract commonly co-occur, no studies have investigated the impact of cataract surgery alone in this setting.

Objective: To analyze the visual impact and cystoid macular edema (CME) risk with cataract surgery in eyes with primary ERM.

Design: Retrospective clinical database study; Data extraction: March 2015; Data collection: July 2003 to March 2015

Setting: Multicenter, 8 locations in the United Kingdom (UK)

Participants: Cataract surgery data of 217,557 eyes were extracted from the electronic medical record of the UK National Health Service. After exclusion of 57,561 eyes with combined surgery, prior vitrectomy, co-pathology, and complications, 812 eyes with primary ERM and 159,184 reference eyes were analyzed.

Main Outcomes and Measures: We report on visual acuity (VA), the incidence of CME, and the need for ERM surgery.

Results: Mean age of ERM eyes was 73.7 (SD 9.23) and 41% were male; mean age of reference eyes was 74.4 (SD 12.19) and 48.6% were male. ERM eyes assessed at 4-12 weeks postoperatively gained 0.27 (SD 0.32) LogMAR units (~3 Snellen lines), with 44.6% improving by ≥ 0.30 LogMAR units (≥ 3 Snellen lines), and 7.1% worsening by ≥ 0.30 LogMAR units. Reference eyes gained 0.44 (SD 0.26) LogMAR units (~4 Snellen lines), with 62.8% improving by ≥ 0.30 LogMAR units, and 2.7% worsening by ≥ 0.30 LogMAR units. While all eyes with preoperative VA $\leq$ 20/40 improved, only reference eyes with preoperative VA > 20/40 showed improvement. Cystoid macular edema developed in 8.6% of ERM eyes and 1.38% of reference eyes ($p < .001$). Epiretinal membrane surgery was performed in 6.6% of ERM eyes.

Conclusion and Relevance:

We found a significant improvement in VA of 0.27 LogMAR units (~3 Snellen lines) in eyes with ERM. Eyes with ERM and VA $\leq$ 20/40 showed more benefit after cataract surgery than those with better preoperative vision. However, compared to eyes without ERM, there were significantly higher rates of CME and a lower postoperative VA gain.

Introduction:

Primary epiretinal membrane (ERM) is a common disorder caused by the proliferation of glial tissue on the surface of the macula.[1, 2] While one autopsy-based study noted an incidence of 5.4%, its prevalence ranges from 4-18.5% in population-based studies.[2-9] Patients with ERM may experience vision loss, distortion, metamorphopsia, and micropsia.[2] However, a significant proportion of up to 90% may remain asymptomatic.[6, 10] Age-related cataract is the leading cause of blindness worldwide for which surgery is commonly performed.[11] Epiretinal membrane and cataract commonly co-occur and the detection, grading, and assessment of the visual significance of each factor may be limited by the other.[12] Furthermore there could be an underestimation of the prevalence and severity of ERM in patients with cataract.[2, 10, 12, 13] Studies have demonstrated positive and equivalent benefit of combined (pars plana vitrectomy [PPV] / ERM peel [MP] + cataract surgery) vs. consecutive surgery (PPV/MP, then cataract surgery), with vision improvements in the range of 0.2-0.3 LogMAR units (~2-3 Snellen lines) postoperatively.[14-18] However, no large studies have analyzed the visual impact of cataract surgery alone in eyes with co-existing ERM.

In the United States, "big data" is advancing research and clinical practice in ophthalmology by allowing for large scale examination of complex medical and surgical questions through the use of Medicare and the Intelligent Research in Sight (IRIS) registry.[19] The United Kingdom (UK) National Health Service (NHS) has provided a similar detailed cataract surgery dataset developed by the UK Royal College of Ophthalmologists.[20] In this multicenter retrospective database study, we utilize electronic medical record (EMR) data from the UK NHS to investigate the impact of cataract surgery alone in the setting of ERM. We describe the effects on visual acuity (VA), the development of cystoid macular edema (CME), and the need for consecutive PPV/MP surgery in this cohort. We include a reference group undergoing cataract surgery in the absence of ERM for comparison.

Methods:

Data Extraction

Datasets from eight UK NHS departments using the same EMR (Medisoft Ophthalmology; Medisoft Limited, Leeds, United Kingdom) were obtained, extracted, and pooled to a centralized database for analysis. A recent study by Chu, et al. (2016) details standards of care at these clinic sites.[20] A study period of twelve years (July 2003 - March 2015) was selected to provide a large cohort with sufficient follow-up information. Fields extracted include: gender, laterality, pre- and postoperative VA, operative complications, diabetic status, presence of ERM, presence of CME, need for additional surgery, and time of follow-up. Race information was not extracted, however, based on the geographic location of the contributing centers, the population studied is predominantly Caucasian. The lead clinician and Caldicott Guardian (who oversees data protection) at each center gave approval for the data extraction.[20] This study was conducted in accordance with the Declaration of Helsinki, the UK Data Protection Act and National Institute for Health Research (NIHR) guidance on ethical approval.

Exclusion Criteria and Data Categorization

Eyes were categorized on the basis of the presence or absence of ERM prior to cataract surgery. Eyes undergoing combined surgery and those with visually significant comorbidities or secondary ERMs, intraoperative complications (posterior capsular rupture with or without vitreous loss or dropped nuclear

fragments), or missing preoperative data were excluded. Due to the anonymized extraction of records, patients who underwent bilateral sequential surgery during the study period had both eyes included, and data on individual eyes were treated as independent for analyses.

Outcome Variables

Our two main outcome variables were VA and the incidence of CME. Visual acuity was defined as the best value of uncorrected or corrected distance VA available at each time period. Preoperative VA was that recorded closest to the date of cataract surgery, no more than three months prior. Follow up was divided into three different time periods: 0-4 weeks, 4-12 weeks, and 12-24 weeks. As postoperative recovery is usually complete at 4 weeks, 4-12 week postoperative VA was chosen as the primary visual outcome for this study and is included in the text. (Tables 2A and B include VA results at other follow up intervals). In eyes that developed CME or worsening of ERM requiring vitrectomy surgery, VA was included as measured at a time point, not related to the development or resolution of pathology. Visual acuity was measured in either Snellen fractions or logarithm of minimum angle of resolution (LogMAR) units. Snellen fractions were converted to LogMAR units for analysis during data extraction, with counting fingers (CF), hand motions (HM), light perception (LP), and no light perception (NLP) assessed as 2.10, 2.40, 2.70, and 3.00 LogMAR units, respectively, consistent with previous publications.[21-23]

Postoperative CME was defined as a recorded diagnosis of CME within 90 days of surgery. For diabetic eyes, a newly recorded diagnosis of CME (or clinically-significant macular edema) with a documented absence on the date of the preoperative examination was considered diagnostic. Although optical coherence tomography (OCT) and/or fluorescein angiography (FA) were likely used for the diagnosis of CME, interpretations of these studies were not recorded consistently preventing their analysis. Associated factors such as diabetes and prostaglandin analogue (PGA) use were analyzed. The record of perioperative NSAID use was incomplete, limiting analysis.

Statistical Analysis

Data was analysed using multiple t-test analyses with the Holm-Šídák method for comparing mean values, Fisher's exact test for proportional differences, and multiple and logistic regression analyses. The *p*-value threshold for statistical significance was .05. The time from cataract surgery to development of CME and PPV/MP were modeled using Kaplan-Meier survival curves, in which the failure events were the development of postoperative CME and PPV/MP surgery, respectively.

Results:

Demographics of Study Eyes

There were of 217,557 eyes that underwent phacoemulsification cataract surgery with intraocular lens implantation. This included 2,243 eyes with ERM and 215,314 without ERM. Figure 1 shows the distribution of eyes and defines filtered co-pathology. Of the 2,243 eyes that had ERM, 1,046 were excluded on the basis of combined surgery, 286 for prior PPV, 84 for significant co-pathology, and 15 for operative complications. This left 812 eyes with visually-significant cataract and primary ERM which had undergone uncomplicated cataract surgery. Of the 215,314 eyes which underwent cataract surgery in the absence of ERM,

11,192 were excluded on the basis of combined surgery, 40,254 for significant co-pathology, 4,566 for operative complications, and 118 for missing preoperative VA data. This left a reference group of 159,184 eyes having undergone uncomplicated cataract surgery in the absence of ERM.

Demographic characteristics and mean preoperative VA of the study eyes are shown in Tables 1 and 2A. In the ERM group, 404 were right eyes, and 408 were left. The reference group included 80,987 right eyes and 78,197 left. Mean patients' age at the time of surgery was 73.7 (range 23-96, SD 9.23) in the ERM group and 74.4 (range 19-99, SD 12.19) in the reference group. There was no difference in the mean, non-segregated, preoperative VA between the ERM and reference groups (0.61±0.44 LogMAR [Snellen 20/80] vs. 0.59 ± 0.49 LogMAR [Snellen 20/80], respectively). However, percentages of diabetic eyes differed between groups as did the prior history of diabetic macular edema (DME), Table 1.

Of the ERM group, 663 eyes (81.7%) were assessed during follow up: 394 eyes (48.5%) at 0-4 weeks, 448 eyes (55.2%) at 4-12 weeks, and 273 eyes (33.6%) at 12-24 weeks. Of the reference group, 123,084 eyes (77.3%) were assessed during follow up: 60,810 eyes (38.2%) at 0-4 weeks, 77,408 (48.6%) at 4-12 weeks, and 37,180 (23.4%) at 12-24 weeks. In the ERM group, preoperative VA did not differ between eyes assessed at follow up and those lost to follow up, however eyes lost to follow up had a lower incidence of diabetes (22.15% and 15.8%, respectively).

Visual Acuity Assessment

Tables 2A and B detail changes in VA in the ERM and reference groups at all postoperative time points. Among 448 eyes (55.2%) in the ERM group assessed at 4-12 weeks postoperatively, mean change in visual acuity was a gain of 0.27 (SD 0.32) LogMAR units (~3 Snellen lines), with 200 (44.6%) improving by ≥ 0.30 LogMAR units (≥ 3 Snellen lines), and 32 (7.1%) worsening by ≥ 0.30 LogMAR units. Among 77,408 (48.6%) reference eyes assessed at 4-12 weeks postoperatively, mean change in visual acuity was a gain of 0.44 (SD 0.26) LogMAR units (~4 Snellen lines), with 48,583 eyes (62.8%) improving by ≥ 0.30 LogMAR units, and 2,125 eyes (2.7%) worsening by ≥ 0.30 LogMAR units.

To control for unmatched differences in preoperative characteristics, multiple and logistic regression analyses were conducted. In both models, age, preoperative VA, presence of diabetes, presence of PDR, and history of DME were chosen as the predictor variables, in addition to the presence of ERM. The criterion variable (tested outcome) was mean postoperative VA at 4-12 weeks for the multiple regression analysis and the likelihood of improvement of VA by ≥ 0.3 LogMAR units for the logistic regression analysis. Both models were significant ($p < .001$), and all predictable variables were statistically significant except for diabetic status. In the logistic regression analysis, the presence of ERM was associated with a decrease in the odds of achieving improvement of VA of ≥ 0.30 LogMAR, by a factor of 0.41 (95% CI 0.238 to 0.692, $p < .001$) (Table 4).

To evaluate the benefits of cataract surgery as stratified by preoperative VA (better than 20/40 vs. 20/40 or worse), a subgroup analysis was performed. Among 63 ERM eyes and 14,744 reference eyes with preoperative vision > 20/40 (< LogMAR 0.30), postoperatively, vision worsened by 0.04 LogMAR units (95% CI -0.018 to 0.098, < 1 Snellen line) in the ERM group and improved by 0.06 LogMAR units (95% CI -0.063 to -0.057, < 1 Snellen line) in the reference group.

Among 385 ERM eyes and 62,415 reference eyes with preoperative vision ≤ 20/40 (≥ LogMAR 0.30), vision improved by 0.32 LogMAR units (95% CI -0.355 to -0.286, ~3 Snellen lines) in the ERM group and by 0.57 LogMAR units (95% CI -0.572 to -0.568, ~6 Snellen lines) in the reference group.

Postoperative Cystoid Macular Edema

Cystoid macular edema developed in 57 eyes (8.6 %, 95% CI 6.69 to 10.98%) in the ERM group and 1,731 eyes (1.38 %, 95% CI 1.32 to 1.45%) in the reference group ($p < .001$). The mean time from cataract surgery to the initial clinical detection of CME was 38.2 days (median: 29; range: 8 - 84) in the ERM group and 39.8 days (median: 34; range 15.7 – 63.9) in the reference group.

We analyzed the incidence of CME in diabetics and PGA users (Table 3, eFigure A). A higher proportion of diabetic eyes in the ERM group (20 eyes, 11.3%) developed CME than in the reference group (758 diabetic eyes, 3.3%, $p < .001$). Upon stratification by retinopathy grade, there were increases in the incidence of CME with increasing grades of diabetic retinopathy, but a significant difference between groups was not detected. A higher proportion of ERM eyes with PGA use developed CME as compared to reference eyes with PGA use, 10.4% vs. 1.7%, respectively. Excluding eyes with history of diabetes or PGA use, 30 eyes (7.14%) in the ERM group and 829 eyes (0.89%) in the reference group developed CME.

Consecutive Epiretinal Membrane Surgery

Forty-three eyes (6.6%) in the ERM group underwent PPV/MP surgery following cataract surgery, eFigure B. Median time from cataract surgery to PPV/MP was 28 weeks (mean: 85.9; range: 22-262). Of those undergoing PPV/MP, 11 eyes (25.6 %) had ≥ 0.30 LogMAR units (~3 lines) of VA loss and 6 (13.9%) exhibited postoperative CME. Vision loss was a significant predictor for the need for PPV/MP with (6/35) 17.1% of those who lost vision (≥ 0.30 LogMAR units) requiring surgery vs. 37/627 eyes (5.9%) where vision did not worsen by ≥ 0.30 LogMAR units ($p = .016$).

Discussion:

This study examined the impact of cataract surgery alone in patients with coexisting cataract and primary ERM. It was based on EMR data of 217,577 eyes which underwent cataract surgery at eight sites in the UK. In this cohort, we found that cataract surgery in eyes with ERM was associated with an improvement in VA of 0.27 LogMAR units (~3 Snellen lines), substantial VA gain (≥ 0.30 LogMAR units) in 44.6%, and a substantial loss in 7.1%. Our data also suggests that compared to eyes without ERM, there are increased rates of CME, and a decreased chance for substantial visual gain.

While direct comparison with other studies is difficult due to variations in reporting, the levels of improvement we observed after cataract surgery in the setting of ERM are comparable with data from studies of combined and consecutive PPV/MP and cataract surgery. Such studies have shown improvement of 0.20 to 0.34 LogMAR units (~2-3 Snellen lines) [16,17,24] To evaluate the benefits of cataract surgery in eyes with good preoperative vision, we conducted a subgroup analysis of VA gain stratified by preoperative vision category. Eyes with ERM and mean preoperative VA better than 20/40 demonstrated no mean improvement in VA, while eyes with ERM and mean preoperative VA of 20/40 or worse exhibited a substantial improvement in VA of 0.32 LogMAR units (~3 lines). While a

possible ceiling effect may have limited the potential for improvement in both the ERM and reference groups for eyes with good vision at baseline, these results suggest that eyes with ERM and VA 20/40 or worse (≥ LogMAR 0.30) may be more likely to benefit from cataract surgery with improvement in VA.

Though one study failed to show worsening of ERM after cataract surgery,[25] others have described progression in as many as 45% of cataract surgery patients over a 3-year period.[13, 26, 27] In our study, 7.1% of eyes with ERM (vs. 2.7% of reference eyes) assessed at 4-12 weeks postoperatively demonstrated VA worsening by ≥ 0.30 LogMAR units. Nine of these 32 eyes (28.1%) had developed postoperative CME. Additionally, approximately 7% required consecutive PPV/MP surgery. Taken together, these findings indicate possible worsening of ERM in these eyes, however, other factors including uncorrected refractive error or unresolved CME could have contributed to this decrease in vision.

Cystoid macular edema is a known complication of cataract surgery, which leads to more postoperative visits and may impact final best-corrected VA.[28] The reported incidence of CME following uncomplicated cataract surgery in a normal eye is 1-2%.[29] A study by Henderson, et al. (2007), demonstrated a 7% incidence of postoperative CME in eyes with ERM undergoing cataract surgery.[28] In our study, the incidence of CME was 8.6% in eyes with ERM. Diabetic retinopathy is a risk factor for CME after cataract surgery, [20, 28] its risk being higher with increasing grades of retinopathy.[20] Our data indicate that the presence of ERM further increases the risk of postoperative CME with diabetes by more than 3-fold (from 3.3 to 11.3%). Although the incidence of CME was higher with increasing grades of diabetic retinopathy and ERM as compared to those without ERM, numbers of eyes in these subgroups were small, and these differences were not statistically significant. Mixed results exist on on the association between PGA use and postoperative CME.[20,28,30,31] We found the risk of CME in eyes without ERM to be 1.79% with PGA use. However, the presence of co-existing ERM significantly increased this risk by more than 5-fold (10.4%).

Our study is limited by its non-randomized, retrospective design; therefore it may be argued that the improvement we observed in VA may be subject to selection bias as eyes with more severe ERMs may have been selected for combined cataract and PPV/MP surgery from the outset. This may also explain the small number of consecutive PPV/MP surgeries recorded in our study. Short follow up time may have also influenced the detected worsening of ERM and the need for PPV/MP in the long-term.The lack of raw OCT / FA data makes it impossible to grade the severity or worsening of ERM, differentiate ERM-related macular thickening from CME, and elucidate swelling of the optic nerve. High loss to follow up and unaccounted differences in ERM severity, diabetes prevalence, and history of DME may also have influenced the visual outcomes. As such, severity of ERM should remain a major consideration in determining whether primary cataract surgery would be appropriate for a given patient.[10, 12] Qualitative changes in vision including distortion, metamorphopsia, and micropsia may also help to distinguish the influence of ERM from cataract and to determine which surgical approach would be most beneficial.[2]

As cataract surgery is commonly performed and ERM may co-occur in a substantial proportion of patients,[12] our findings may well influence clinical practice. It is also important to note that patients over 65 years of age often have greater access to cataract surgery than retina surgery, and access to a retina specialist may be limited to some individuals in certain geographic locations. Our findings may help the cataract surgeon to determine whether a patient may benefit from cataract surgery primarily, or if they should be referred to a retina specialist. They may also aid in the discussion of the risk for CME in this setting, and

expectations regarding visual outcome. Other strengths of our study include its use of "big data" from multiple sites, with analysis of prospectively collected structured data sets for more than 217,000 eyes, more than 800 having undergone cataract surgery in the setting of ERM. As such, our findings are more generalizable and avoid the potential biases inherent to small retrospective studies or studies at single institutions.

In conclusion, examining the effect of cataract surgery on vision in the setting of ERM, we found a mean change in VA of 0.27 LogMAR units (~3 Snellen lines), a substantial visual gain in 44.6%, and a substantial loss in 7.1%. Our data indicate that individuals with ERM and VA worse than 20/40 may benefit more from cataract surgery than those with better preoperative VA. However, our data suggests that compared to eyes without ERM, the rates of CME will be increased from 5.24 to 9.66% with a 13.2 to 23% decreased chance for visual gain.

Acknowledgements

Data Integrity: Ahmed B. Sallam and Donald W. Gauldin had full acesss to the data in this study and take responsibility for the integrity of the data and accuracy of the data analysis.

Dedication:

This work is dedicated to the memory of Robert L Johnston, MD FRCOphth (1966-2016), who played a major role in designing this study and sadly passed away before the completion of the work.

Collaborators:

Clare Bailey – data collection, Arijit Mitra – data collection, Atul Varma – data collection, Martin Mckibbin – data collection, Muhammed Tahir – data collection, Nick Lee – data collection, and Peter Scanlon – data collection

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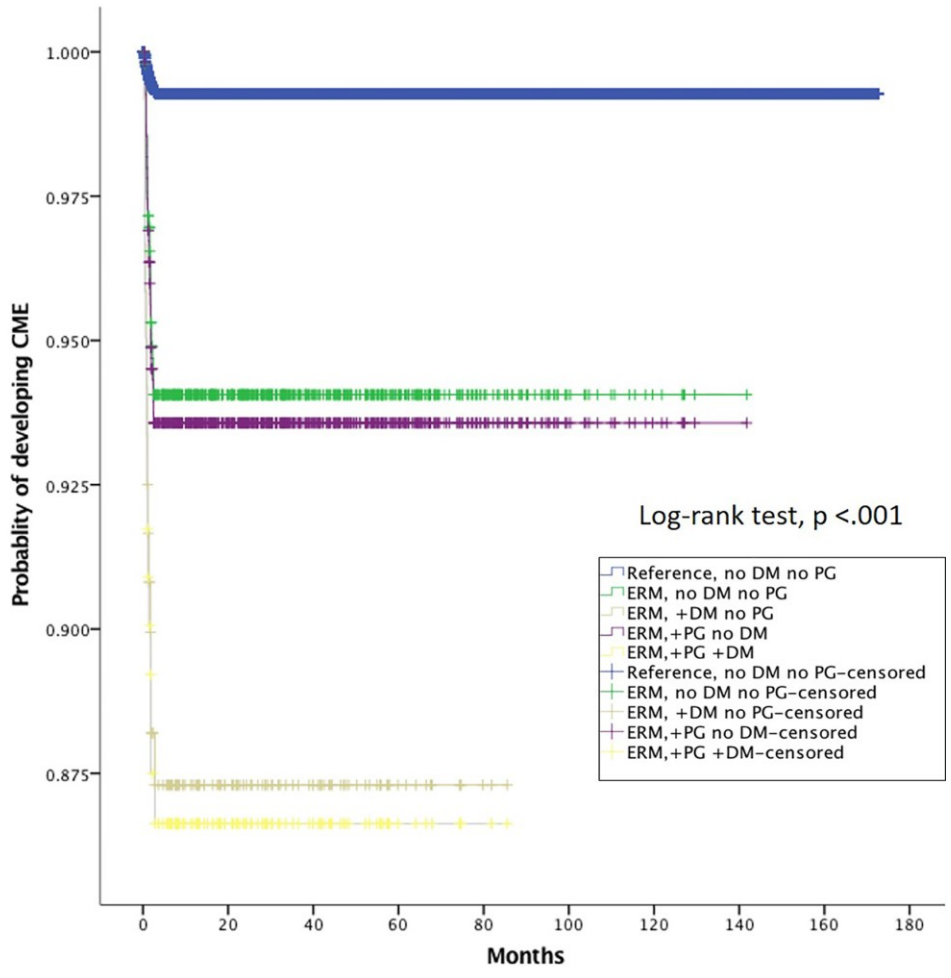
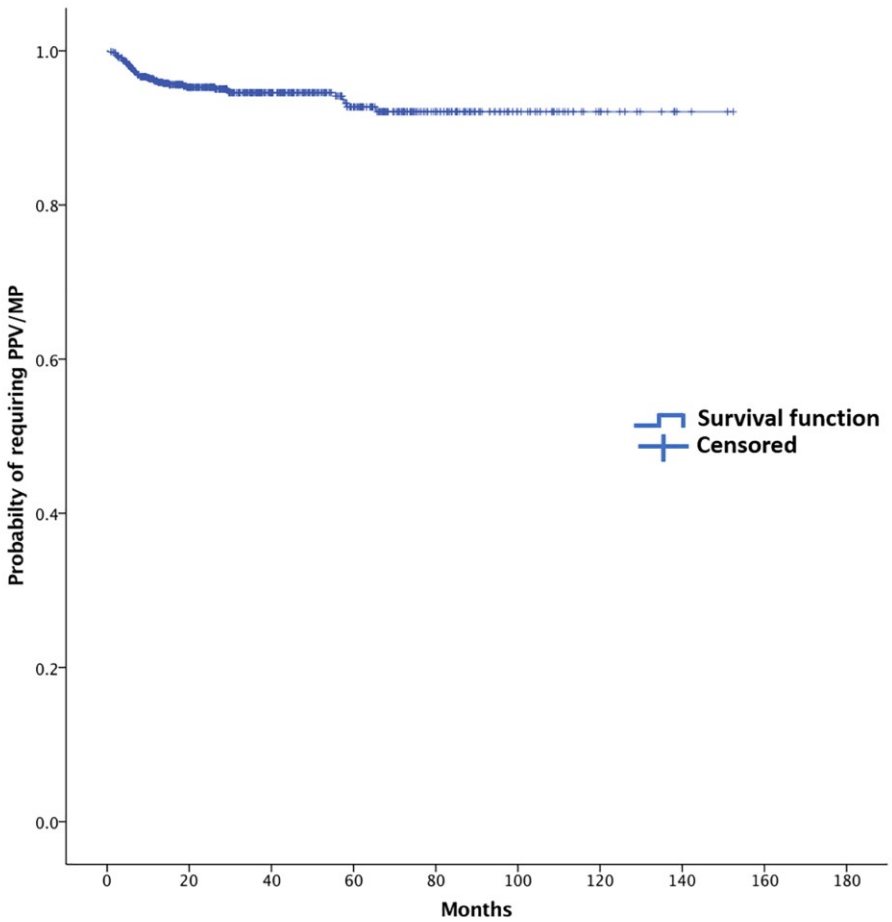
Figure Legends

Figure 1: Flowchart showing study design / filtering. “Co-pathology” and “Complications” were filtered as discussed in the “results” section. Combined surgeries include cataract surgeries as combined with pars plana vitrectomy, corneal grafts, trabeculectomy, tube shunts, or intravitreal injections at the time of surgery. ERM = epiretinal membrane; RVO = retinal vein occlusion; ARMD = age-related macular degeneration; PXS = pseudoexfoliation syndrome



eFigure 2: Kaplan-Meier curve showing the time from cataract surgery to development of cystoid macula edema (CME), in which CME was modelled as the failure event. Eyes were stratified based on the presence of risk factors for CME. DM = diabetes mellitus; ERM = epiretinal membrane; PGA = prostaglandin analogue; reference = reference group (no ERM). Log-rank test was significant ($p < .001$) indicating difference in the rate of failure between the studied cohorts.



eFigure 3: Kaplan-Meier curve showing the time from cataract surgery to pars plana vitrectomy and epiretinal membrane peel (PPV/MP) surgery, in which PPV/MP was modelled as the failure event. PPV/ERM = Pars plan vitrectomy + epiretinal membrane peel.

Tables

Table 1

	Reference Group (Range, SD)	ERM Group (Range, SD)
Age	74.4 (19-99, 12.19)	73.7 (23-96, 9.23)
	Reference Group (Eyes n, Frequency %)	ERM Group (Eyes n, Frequency %)
Laterality Right Left	 80,987 (50.9 %) 78,197 (49.1%)	 404 (49.7%) 408 (50.3 %)
DM	28, 923 (18.2%)	248 (30.5%)
DM Status Unknown or not Specified	25,896 (16.3%)	75 (9.2%)

NPDR	2,990 (1.9%)	103 (12.7%)
PDR	661 (0.42%)	70 (8.6%)
Prior Diabetic Macular Edema	409 (0.26%)	10 (1.2%)
PGA Use	9,241 (5.81%)	74 (9.1%)
DM and PGA Use	1,931 (1.21%)	18 (2.2%)

Table 1: Demographics and Risk Factors. P-values were calculated using Fisher's exact test.

DME = diabetic macular edema; DM = diabetes mellitus ERM = epiretinal membrane; PGA = prostaglandin analogue.

Table 2A

	Reference Group Mean ± SD (n); 95% CI	ERM Group Mean ± SD (n); 95% CI	p-Values
Preoperative VA	0.59±0.49 (159,184)	0.61±0.44 (812)	p = .319
Δ VA at 0-4 weeks	-0.35±0.31 (60,810); -0.353 to -0.348	-0.19 ± 0.37 (394); -0.226 to -0.153	p < .001
Δ VA at 4-12 weeks	-0.44 ±0.26 (77,408); -0.442 to -0.438	-0.27±0.32 (448); -0.300 to -0.240	p < .001
Δ VA at 12-24 weeks	-0.40 ± 0.28 (37,180); -0.403 to -0.397	-0.18±0.42 (273); -0.230 to -0.130	p < .001
Preoperative VA (VA > 20/40, < LogMAR 0.30)	0.14 ±0.10 (30,471)	0.16±0.80 (103)	p = .319
Δ VA at 0-4 weeks	0.01 ±0.24 (10,566); 0.005 to 0.015	0.08±0.22 (40); 0.010 to 0.150	p = .065
Δ VA at 4-12 weeks	-0.06 ± 0.19 (14,744); -0.063 to -0.057	0.04±0.23 (63); -0.018 to 0.098	p < .001
Δ VA at 12-24 weeks	-0.04 ±0.20 (6,736); -0.045 to -0.035	0.03±0.18 (32); -0.035 to 0.095	p = .048
Preoperative VA (VA ≤ 20/40, ≥ LogMAR 0.30)	0.74±0.54 (128,713)	0.69±0.43 (709)	p = .319

Δ VA at 0-4 weeks	-0.48±0.32 (50,177); -0.483 to -0.477	-0.24±0.38 (354); -0.280 to -0.200	p < .001
Δ VA at 4-12 weeks	-0.57±0.27 (62,415); -0.572 to -0.568	-0.32±0.33 (385); -0.355 to -0.286	p < .001
Δ VA at 12-24 weeks	-0.54±0.30 (30,374); -0.543 to -0.537	-0.23±0.43 (241); -0.285 to -0.175	p < .001

Table 2A: Preoperative Mean Vison and Postoperative Mean Vision Changes. All visual outcomes are described in logarithm of minimal angle of resolution (LogMAR) units. P-values were calculated using the Holm-Sidak method for multiple comparisons;

Table 2B

	Reference Group Eyes (Frequency %); 95% CI	ERM Group Eyes (Frequency %); 95% CI	p-Values
Improved ≥ 0.30 LogMAR units (15 letters)			
Within 4 weeks	33,175 (54.6%); 54.2 to 55.0 %	172 (43.7%); 38.8 to 48.6%	p < .001
4-12 weeks	48,583 (62.8%) ; 62.5 to 63.1%	200 (44.6%); 40.1 to 49.3	p < .001
12-24 weeks	22,290 (60.0%); CI 59.5 to 60.5%	126 (46.2%); CI 40.3 to 52.1 %	p < .001
Worsened ≥0.30 LogMAR units (15 letters)			
Within 4 weeks	3,175 (5.2%); CI 5.0 to 5.40 %	34 (8.6%); CI 6.2 to 11.8%	p < .001
4-12 weeks	2,125 (2.7%); CI 2.6 to 2.8%	32 (7.1%); CI 5.1 to 9.8%	p < .001
12-24 weeks	1,223 (3.3%); CI 3.1 to 3.5 %	23 (8.4%); CI 5.7% to 12.3%	p < .001

2B: Improvement or Worsening of Vision. Percentages of eyes which improved or worsened by ≥ 0.30 logarithm of minimal angle of resolution (LogMAR) units are represented. P-values were calculated using Fisher's exact test. ERM= epiretinal membrane; VA = visual acuity; Δ VA= change in mean visual acuity.

Table 3

	Reference Group Eyes/n (Frequency %); 95% CI	ERM Group Eyes/n (Frequency %); 95% CI	p-Values
All eyes	1,731/125,435 (1.38%); 1.32 to 1.45%	57/663 (8.6%); 6.69 to 10.98%	p < .001
No DM/Unknown	951/100,105 (0.95%); 0.89 to 1.01%	37/487 (7.6%); 5.56 to 10.30%	p < .001
Diabetic Eyes	758/22,970 (3.3%); 3.08 to 3.54%	20/177 (11.3%); 7.43 to 16.81%	p < .001
NPDR	303/2,745 (11.04%); 9.92 to 12.27%	10/57 (17.5%); 9.82 to 29.37%	p = .212
PDR	92/576 (16.0%); 13.23 to 19.22%	6/29 (20.1%); 9.51 to 37.31%	p = .451
Prior DME	155/352 (44.0%); CI 39.94 to 49.26%	2/8 (25%); 4.44 to 59.07%	p = .473
PGA	122/7,176 (1.7%); 1.43 to 2.03%	7/67 (10.4%); 5.15 to 20.03%	p < .001
PGA + no DM	79/5,896 (1.34%); 1.08 to 1.67%	6/52 (11.5%); 5.40 to 22.97%	p < .001
No PGA, no DM	829/93,146 (0.89%); CI 0.83 to 0.95%	30/420 (7.14%); 5.05 to 10.01%	p < .001

Table 3: Incidence of Postoperative Cystoid Macular Edema. Percentages of eyes which developed cystoid macular edema are represented in total and as associated with risk factors. P-values were calculated using Fisher's exact test. DME = diabetic macular edema; DM = diabetes mellitus ERM = epiretinal membrane; NPDR = non-proliferative diabetic retinopathy; PDR = proliferative diabetic retinopathy; PGA = prostaglandin analogue.

Table 4

Predictable Variable	Exp(B) Coefficient	95% CI for Exp(B)	P value
Age	1.022	1.012 to 1.032	P .<001
Preoperative VA	0.016	0.010 to .025	P .<001
Diabetes	0.000	0.000	P = .999
ERM	2.464	1.445 to 4.203	P .<001
PDR	2.724	2.052 to 3.617	P .<001
DME	2.589	1.855 to 3.164	P .<001

Table 4: Logistic regression predicting the likelihood of demonstrating an improvement of VA of ≥ 0.30 LogMAR after cataract surgery. CI = confidence interval; DME = diabetic macular edema; DM = diabetes mellitus ERM = epiretinal membrane; Exp.= Exponential; PDR = proliferative diabetic retinopathy; VA = visual acuity.